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Maximal Feeding Depth of Walruses

F.H. FAY[1] and J.J. BURNS[2]

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ABSTRACT. Walruses (*Odobenus rosmarus*) feed mainly on benthic invertebrates in waters less than 80 m deep, and they have been presumed to be incapable of diving to greater depths. Reported here are seven walruses whose stomachs contained significant amounts of benthic sediments and food, some of which must have been ingested in waters more than 100 m deep. Walruses may be able to dive to depths much greater than 100 m, but they usually have little reason to do so, since their benthic prey are most abundant in shallower waters.

Key words: walrus, *Odobenus*, diving, feeding, Bering Sea

RÉSUMÉ. Les morses (*Odobenus rosmarus*) mangent surtout des benthiques invertébrés dans les eaux qui ne dépassent pas 80 m de profondeur et l'on suppose qu'ils sont incapables de plonger plus bas. Nous rendons compte ici de la prise de sept morses ayant dans leurs estomacs des quantités importantes d'aliments et de sédiments benthiques, dont une certaine quantité a dû être ingérée à une profondeur de plus de 100 m. Les morses sont peut-être capables de plonger à des profondeurs qui dépassent 100 m, mais il y a très peu de raison qu'ils le fassent à cause du manque de proie à cette profondeur.

Mots clés: morse, *Odobenus*, plongée, alimentation, Mer de Bering

Traduit par V. Pelletier, l'Université d'Alaska-Fairbanks.

РЕЗУМЕ. Моржи (Odobenus rosmarus) питаются главным образом бентическими беспозвоночными в водах мельче 80 м, и полагалось что они не имели способности нырять ниже. Здесь предоставляем доклад о семи моржах, в чьих желудках было значительное количество бентоса и бентонного гравия, которое добивалось в водах глубже 100 м, где моржи наверно питались некоторым количеством этих материалов. Возможно что моржи имеют нырять глубже 100м, но мало причин почему бы им нырять в такие глубины, так как пища становится самая обильная в более мелких водах.

Ключевые слова: морж, Odobenus, нырание, питание, Берингово море

Перевод по С. Лекомт, Университет Аляски-Фэрбанкс.

Walruses, *Odobenus rosmarus* (Linnaeus), reside mainly in seasonally ice-covered seas of the Arctic and Subarctic. Because they feed primarily on bivalve mollusks (Chapskii, 1936; Tsalkin, 1937; Nikulin, 1941; Brooks, 1954; Loughrey, 1959), they must dive to the bottom of the sea for most of their food. Walruses are not known to bottom-feed in waters deeper than 80 m, which has led some observers to hypothesize that either the walruses are incapable of diving to greater depths (Vibe, 1950, 1956; Mansfield, 1958) or their preferred foods are scarce in deeper waters (Brooks, 1954; Loughrey, 1959). They do venture occasionally into areas of deeper water (Vibe, 1950; Loughrey, 1959; Fay, 1982; Finley and Renaud, 1980), but they are believed to subsist there by preying on pelagic organisms, particularly phocine seals (Vibe, 1950).

In March 1985, we had an opportunity to examine the stomachs from 13 walruses that were killed on ice floes over waters 102-117 m deep in the central Bering Sea. Six of those stomachs were nearly empty, containing only trace amounts of digesta from a previous meal, but four contained partly digested food, and the last three contained food that was very fresh (undigested), along with associated benthic sediments. The presence of fresh, undigested prey, which consisted of infaunal and epifaunal mollusks (fleshy parts only; walruses usually do not ingest the shells) and crustaceans (Table 1), indicates that at least the last three animals had fed very recently, probably in the immediate vicinity of the floes where they lay when killed. The partly digested food in the other four stomachs was of the same kind as that in those three, but it evidently had been eaten some time earlier, possibly a few km away. The nearest waters 80 m and less in depth were at least 50-95 km away from the location where the animals were killed. At the normal swimming speed of walruses (up to about 10 km·h^{-1}; Fay, 1982), those shallow waters were at least 5-9 h distant. Had the walruses eaten their

TABLE 1. Kinds and numbers of prey in the seven walrus stomachs containing fresh (F) and partly digested (P) food, by date, location, and depth of water

Kinds of prey (genera) in stomach	21 March 1985 60°34.4′N lat. 174°49.9′W long. depth 102-104 m			24 March 1985 60°43.8′N lat. 175°33.1′W long. depth 110-113 m			
	(F)	(P)	(P)	(F)	(F)	(P)	(P)
Whelks (*Buccinum, Neptunea,* and *Clinopegma*)	58	2	284	495	6	434	1011
Moon snails (*Natica* and *Polinices*)	10	4	31	14	2	13	69
Cockles (*Serripes* and *Clinocardium*)	17	0	0	39	0	28	2
Nuculanid clams (*Yoldia*)	27	0	0	102	0	0	0
Tellinids (*Tellina* and/or *Macoma*)	2	0	0	4	0	5	2
Ample panomya (*Panomya*)	0	0	0	2	0	1	2
Cephalopods (*Octopus*)	0	0	1	2	0	4	0
Hermit crabs (*Pagurus*)	0	0	0	10	0	67	5
Snow crabs (*Chionoecetes*)	3	7	13	55	20	33	77
Echiuroids (*Echiurus*)	0	0	0	2	0	1	0
Priapulids (*Priapulus*)	0	0	2	2	1	0	0
Polychaetes (indeterminate)	0	2	4	0	5	1	3
Est. total volume (ml)[1]	510	—	—	3675	680	—	—

[1]Not measured for these specimens; based on specimens of the same genera from walruses taken in southeastern Bering Sea (Fay *et al.*, 1984).

[1]Institute of Marine Science, University of Alaska, Fairbanks, Alaska 99775, U.S.A.
[2]Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska. Current address: Living Resources Inc., P.O. Box 83570, Fairbanks, Alaska 99708, U.S.A.

last meal there, 5-9 h earlier, the digestion of it in their stomach certainly would have been completed before they were captured. Pinnipeds digest their food rapidly (Gurova and Pastukhov, 1974; Parsons, 1977; Miller, 1978; Murie and Lavigne, 1986), and the walrus's digestion is thought to be exceptionally rapid (Murie, 1871).

The bivalves on which walruses feed are abundant in northern seas mainly at depths between 10 and 100 m (Thorson, 1934; Belyaev, 1960; Neiman, 1960; Thompson, 1982). In the Bering Sea, the production of macrobenthos in that range (middle shelf) is an order of magnitude higher than it is on the outer shelf at depths of 100-200 m (Walsh and McRoy, 1986). This is a result of partitioning of primary production to the pelagic food web seaward of the 100 m isobath and to the benthic food web shoreward of 100 m (Cooney and Coyle, 1982).

Judging from our findings, walruses are capable of diving and feeding to depths greater than 100 m in that region, but they probably do not do so very often, because they gain less from it than from feeding in shallower waters. Their geographic distribution, therefore, may be limited less by their diving ability than by the bathymetric distribution of their food.

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